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PATENT APPLICATION No. 76/21902

Title: Drawn container made from a composite sheet

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The present invention relates to a container made of a deep-drawn composite sheet dimensionally stable at high temperatures, for heating ready-prepared meals at oven temperatures of more than 160°C. It is possible to use, as packaging for prepared meals, deep-frozen food and similar products that have to be heated in a hot-air oven, containers drawn from materials which are dimensionally stable at high temperatures such as, for example, a polymethylpentene, a polysulphone, a polyamide or a polyester. However, because of the high cost of their raw material, containers made of such materials are too expensive as disposable packaging. The same applies to their use as disposable packaging for food, for example grilled desserts sprinkled with breadcrumbs, which are cooked ready to be served in the unsealed packaging and which must then be protected by a gastight seal preventing the loss of aroma and the ingress of oxygen.

German Patent Application published under No. 23 04 572 teaches, as packaging for prepared meals, containers drawn from composites consisting mainly of styrene-based polymers with covering layers of polycarbonate. There are also commercially available, for such prepared meals, cups drawn from polypropylene. The containers, drawn both from polypropylene and composites mentioned in the aforementioned German Patent Application No. 23 04 572 are dimensionally stable up to 150 to 160°C at most. By reinforcing the polypropylene with resistant materials, for example glass fibres, it is possible to significantly improve its dimensional stability with respect to sheet, but the reinforced polypropylene can then only be drawn with difficulty since resistant materials are not elastic and, in particular, containers with thin walls and sharp edges fracture at relatively large depths of drawing.

German Patent under formal publication No. 20 52 451 describes thin-walled containers produced

by thermoforming a composite sheet comprising a central layer made of a plastic which is dimensionally stable at high temperature and lateral surfaces made of a plastic having a lower dimensional stability with respect to heat. However, for economic reasons, these containers are not suitable for heating prepared meals at oven temperatures of more than 160°C. If materials that remain dimensionally stable at temperatures of greater than 160°C were to be used for the outer layers of the composite sheet, it would then be unnecessary to make the containers from a composite sheet since a simple sheet made of materials of high dimensional stability with respect to heat would then suffice. However, because of the high cost of their raw materials, such sheets are not taken into account for producing disposable containers. If, as in the preferred embodiment of the aforementioned German Patent No. 20 52 451, standard polystyrene is used for the central layer and polystyrene containing an elastomer for the outer layers of the composite sheet, the container is dimensionally stable only up to temperatures of about 110°C. This known container consequently cannot be used in the field of application in question.

Although temperatures of about 150°C are recommended for the heating of prepared meals, the object of the invention is to produce containers made of an easily drawable composite which withstand, without deforming, a higher temperature load, possibly up to approximately 200°C, as may occur, for example, in the case of an erroneous setting of the oven temperature. The containers must also be able to receive grilled meals.

The containers must also be able to be sealed in a liquid-tight manner but nevertheless be easy to open, even when the closure, as in the heating of prepared meals, has been exposed to high oven temperatures. They are also required to provide good

protection against loss of aroma and against oxygen ingress.

The cost of the composite and of the application of the process must be as low as possible so that the use of the containers as disposable packaging can be envisaged. At the same time, the formation of scrap should be taken into consideration as an important cost factor, since the manufacture of containers gives rise to a considerable amount of scrap in the form of cuttings along the edges, of sheet production scrap and of punching-drawing grids.

The drawn container made of composite sheet according to the invention is characterized in that a central layer of polypropylene containing preferably resistant fillers is provided with two covering layers made of a thermoplastically convertible terephthalate-based polyester, an adhesive is sandwiched between the central layer and each of the two covering layers, the container includes a lid whose surface joined to it consists of polyvinyl chloride, a polysulphone, polycarbonate or a thermoplastically convertible terephthalate-based polyester which differs from the polyester of the covering layers, and this lid is joined to the container by a welded joint.

The use of covering layers made of a terephthalate-based polyester makes the composite easily drawable. The polyester layers allow the central layer to be heated to temperatures above the melting point of polypropylene, at which temperatures, despite the possible presence of inextensible fillers, it may be satisfactorily deformed without any tension. Without these protective layers, the possibly filled polypropylene layer would buckle, form folds, melt and crack, especially if it were taken up on a roll. As a result of the high-temperature forming, the subsequent heating of the container is accompanied by no shrinkage.

If, for example when heating prepared meals, the closure member is heated to high temperatures at the same time as the container and if the welded layer of the lid is composed of polysulphone, polycarbonate or a terephthalate-based polyester which is different from the material of the covering layers of the container, the latter is readily opened. The opening of the welded lid, still easy even after heating, relies on this choice of materials of the two layers to be welded together. If the container must not be exposed to high temperatures before it is closed, a lid made of polyvinyl chloride or of another material, with a polyvinyl chloride as contact layer to be welded, is sufficient to obtain a closure which is easy to open.

In a preferred embodiment of the invention, the covering layers consist of a mostly amorphous polyester which, during the drawing, at least partly passes into the crystalline state. The use of such a preferably amorphous polyester for the covering layers ensures particularly good drawability of the composite. These polyester covering layers partly recrystallize due to the action of the heat of forming just as during the cooling phase and thus form the external reinforcement supporting the container at the high temperatures of the oven.

According to another feature of the invention, the polypropylene interlayer contains fillers which, at the prevailing temperatures, are in the solid state. It is possible to use for this purpose mineral materials, for example glass fibres, talc or similar materials or else particles of plastics having a high melting point.

It is particularly advantageous to take as filler the product obtained from regenerating the composite used for producing the containers. It is possible, for example, to use, for the interlayer, fresh polypropylene granules and, as filler, chopped waste coming from the sheets or from the scrap composite according to the invention due to the

manufacture of the containers. At the same time, it is extremely advantageous to be able to reuse most of the waste from the punching-drawing grids that arises from the manufacture of the containers. Consequently, the cost of the latter is maintained at quite a low level, this being particularly important for disposable packaging.

The containers according to the invention may be heated in any system of ovens, such as hot-air ovens, microwave ovens, etc. Compared with the polypropylene or composite containers according to German Patent Application No. 23 04 572, the maximum permissible oven temperature is 30 to 40°C higher and thus meets the safety requirements of packaging for prepared meals. The containers furthermore have good properties as regards protection against the loss of aroma and the ingress of oxygen. The packaged food may be sterilized in the container. Another advantage of the containers according to the invention resides in the fact that, despite them being sufficiently sealed against liquids, they are easy to open, even after the closed container has been heated to a particularly high temperature.

The invention will be more clearly understood with the aid of the description below of several illustrative examples given purely by way of indication and implying no limitation.

EXAMPLE 1

A container according to the invention was drawn, in the form of a flat two-part bowl having the dimensions of 17 by 22 cm, from a composite formed by assembling, using a commercial polyurethane-based two-component adhesive, a sheet of largely amorphous polyethylene terephthalate 50 µm in thickness, a sheet of polypropylene containing 10% glass fibres and 400 µm in thickness and a sheet of polyethylene terephthalate 50 µm in thickness, the said polyethylene terephthalate being partly converted to the crystalline state. The

drawing took place while heating by infrared radiation with a heating time of 15 s and a cooling time of 10 s. The containers were filled with prepared meals consisting, for example, of chicken fillets in a sauce or a potato puree and they were closed in a sealed manner by the welding of a lid composed of the assembly of a sheet of polycarbonate approximately 50 µm in thickness as welding layer and of a printed paper as information-bearing medium. In the packaging, pricked by a needle through its lid in order to prevent it bulging, the meal, which was stored deep-frozen at -20°C, was heated to the consumption temperature under various conditions in a hot-air circulating oven:

a) at 160°C for a time of 45 minutes;

b) at 180°C for a time of 45 minutes;

c) at 200°C for a time of 30 minutes.

The lid opened easily after cooling slightly for about one minute. No deformation of the container was observed, even after heating to 200°C, although thermal deterioration of the contents could already be clearly seen at this oven temperature, as evidenced by a dry cracked crust and a fried taste of the potato puree.

EXAMPLE 2

A three-layer composite, comprising an outer layer formed from a 50 µm thick sheet of polyethylene terephthalate, a 25 µm thick interlayer made of a blend, in the proportions of 6/3/1, of an ethylene/vinyl acetate copolymer with an acetate content of 40%, of isotactic polypropylene containing 30% talc and of atactic polypropylene, and a 200 µm thick inner layer of isotactic polypropylene bulk-coloured white, was coextruded in the form of lay-flat tubing through an annular die. The tubing after the cooling line was immediately flattened between two cylinders and quenched as rapidly as possible in a water bath. This resulted in a composite sheet having a thickness of approximately 550 µm, from which containers were drawn, as in Example 1; lids comprising

35 µm thick polysulphone sheets were welded on to the containers and the latter were tested under conditions 1b. No deformation of the containers was observed. The welded joint opened easily, even after the heating.

EXAMPLE 3

In an adapter, a 400 µm thick layer of a blend in equal parts of fresh polypropylene granules and of chopped scrap of a composite produced according to Example 2 was coated on both sides with a 10 µm thick layer of an adhesive made of an ethylene/vinyl acetate copolymer containing 32% acetate. By means of a three-layer coextrusion die, this central layer was extruded in an extruder between two polyethylene terephthalate covering layers each having a thickness of 50 µm. The composite sheet thus obtained, having a thickness of approximately 525 µm, was drawn into containers as in Example 1. These containers were filled with a prepared meal and closed by welding on a lid formed by the assembly of approximately 50 µm of polytetramethylene glycol terephthalate and of printed paper. In the test under the conditions of Example 1b, no deformation of the container was observed. The welded joint was still liquid-tight, even after the heating, and was easy to open despite the action of the heat.

EXAMPLE 4

Cups 72 mm in diameter and 30 mm in height were produced by drawing the composite described in Example 1 and were then filled en masse with a dessert. This albuminous dessert was heated in the packaging to a temperature of 220°C by infrared radiators until it had a brown crust. The edges of the cups exhibited no deformation after the crust had formed, thereby making it completely possible for lids, in the form of 150 µm thick clear polyvinyl chloride sheets, to be welded in a sealed manner to the said cups. The oxygen permeability of the welded packaging was 0.2 cm^3, normalized per package and per day, with a pressure difference of 1 bar, at 23°C and with relative humidity

of the air of 50%. The closure opened easily; the strength of the welded joint measured on test pieces 15 mm in width taken from the edge was 7.26 N/15 mm.

EXAMPLE 5

A lid formed by the assembly of a 50 µm thick sheet of polycarbonate and of paper was welded, at a unilateral temperature of 230°C, a pressure of 30 kg/cm^2 and a time of 30 s, to a filled cup made of a composite according to Example 1. The strength of the welded joint measured on test pieces 15 mm in width taken from the edge was 7.36 N/15 mm. After heating the cup, pricked through its lid with a needle, under the conditions in Example 1b, the strength of the welded joint was 7.65 N/15 mm.

CLAIMS

1. Drawn container made of a composite sheet and dimensionally stable at high temperatures, for heating ready-prepared meals at oven temperatures of more than 160°C, characterized in that a central layer made of polypropylene containing fillers, for example resistant fillers, is provided with two covering layers made of a terephthalate-based thermoplastically convertible polyester, an adhesive is sandwiched between the central layer and each of the two covering layers, the container includes a lid whose surface joined to it consists of polyvinyl chloride, a polysulphone, polycarbonate or a terephthalate-based thermoplastically convertible polyester which differs from the polyester of the covering layers, and this lid is joined to the container by a welded joint.

2. Drawn container according to Claim 1, characterized in that the covering layers consist of a predominantly amorphous polyester which, during the drawing, at least partly passes into the crystalline state.

3. Drawn container according to either of Claims 1 and 2, characterized in that the polypropylene interlayer contains fillers which, at the temperatures envisaged, are in the solid state.

4. Drawn container according to Claim 3, characterized in that the product obtained from regenerating the composite used for producing the containers is taken as filler therein.